

METHOD OF MAKING WATER-RESISTANT GYPSUM-BASED ARTICLE

FIELD OF THE INVENTION

The present invention relates to a method of making moisture resistant gypsum-based products, e.g., gypsum boards, reinforced gypsum composite boards, plasters, machinable materials, joint treatment materials, and acoustical tiles, by adding a small amount of a siloxane to the aqueous slurry used to make the gypsum-based product. More particularly, the present invention relates to the addition of a small amount of a dead burned magnesium oxide catalyst to the aqueous slurry to enhance the curing of the siloxane.

BACKGROUND

Gypsum is a naturally occurring mineral which is typically found in old salt-lake beds, volcanic deposits and clay beds. In chemical terms, gypsum is calcium sulfate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). This material is produced also as a by-product in various industrial processes.

When calcium sulfate dihydrate is heated sufficiently, a process called calcining, the water of hydration is driven off and there can be formed either calcium sulfate hemihydrate ($\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$) or calcium sulfate anhydrite (CaSO_4) depending on the temperature and duration of exposure. The term "calcined gypsum," as used herein, refers to both the hemihydrate and anhydrite forms of calcium sulfate.

Calcined gypsum is capable of reacting with water to form calcium sulfate dihydrate which is a fairly hard and rigid product and which is referred to herein as "set gypsum."

An example of a common gypsum product is gypsum board, which is widely used as a structural building panel. Speaking generally, gypsum board comprises a core made from an aqueous slurry of calcined gypsum which hydrates to form set gypsum. Typically, the board has a paper sheet lining adhered to both of its faces.

A characteristic of set gypsum is that it has a tendency to absorb water. To illustrate, a gypsum core containing no water-resistant additives can absorb as much as 40 to 50 wt. % water when immersed therein at a temperature, of 70° F. for about two hours. In applications where the gypsum product is exposed to water or high humidity, this characteristic is undesirable. The absorption of water by the gypsum tends to reduce the strength of the product to render the product vulnerable to microbiological growth, and to cause the facings to delaminate.

Gypsum board may be used also in bathrooms as an underlying surface which is covered with plastic or ceramic tile and for this purpose it is often referred to as a "tile-backing board." In applications such as these, it is important that the gypsum board exhibit good water resistance.

These prior art products, like ordinary gypsum wallboard, gypsum tile, gypsum block, gypsum casts, and the like have relatively little resistance to water. When ordinary gypsum wallboard, for example, is immersed in water, the board quickly absorbs a considerable amount of water, and loses a great deal of its strength. Actual tests have demonstrated that when gypsum board core material was immersed in water for 2 hours at about 70° F., per ASTM Test 1396, water absorption in excess of 40% are common. Many attempts have been made in the past to improve the water resistance of gypsum products. These attempts have included the incorporation of water-resistant materials such as metallic soaps, asphalts, siloxanes, resins, etc., within the calcium sulfate hemihydrate slurry. They have also included attempts to coat the finished

gypsum product with water resistant films or coatings. One specific example of past attempts to waterproof gypsum integrally by the addition of water-repellent substances is disclosed in U.S. Pat. No. 2,198,776 to King and Camp. This shows the incorporation of paraffin, siloxane, asphalt, etc. into the aqueous slurry by spraying the molten material into the slurry.

The present invention relates to an improved method of manufacturing water-resistant gypsum compositions which have incorporated therein a siloxane to impart water resistance to the set gypsum product.

The expression "water resistant" should be understood to mean the ability of a prefabricated structural element as defined above to limit the uptake of water by the plaster substrate, while still retaining the dimensional stability and mechanical integrity of the structural element in question.

Depending on the countries, this water resistance is codified or regulated by specific standards. The ASTM 630/630M-96a and the ASTM 1398 standards require in particular that, when such a gypsum-base article is immersed in water for two hours, the water uptake by the plaster substrate is less than 5% and the water absorption on the surface (called the Cobb equivalent) is less than 1.60 g/m².

This water repellency is achieved by using any process comprising, in general, at least the following steps:

(a) homogeneously mixing a dry material, comprising mostly at least one hydratable calcium sulfate, the abovementioned water-repellent agent, and water and preforming said substrate in the wet state;

(b) drying the preformed substrate in order to obtain said substrate formed in the solid and dry state.

With such a process, it is difficult to control the amount of water-repellent agent incorporated into the plaster substrate, for example in the form of a silicone oil, and therefore the potential of the water-repellent agent is not exploited.

The use of siloxanes to make moisture resistant gypsum-based products, such as gypsum wall board, is well known. Generally, a small amount of a siloxane is added to the aqueous slurry used to make the gypsum-based product and the product is formed and dried. The production of such moisture resistant gypsum-based products is described in U.S. Pat. Nos. 3,455,710; 4,643,771; 5,135,805; 5,220,762; 5,366,810; 5,626,668; 6,100,607 and 6,569,541 among others. It has been found, however, that in some cases the siloxane used to make the gypsum-based product water resistant does not completely cure in a reasonable period of time or does not completely cure at all. In either case, the water resistance does not develop to a satisfactory level.

It is the object of the present invention to provide a method of incorporating siloxane to the slurry along with a catalyst to enhance the curing of the siloxane to accelerate and improve the development of water-resistance in gypsum-based articles.

SUMMARY OF THE INVENTION

The present invention relates to a method of making moisture resistant gypsum-based products, e.g., gypsum boards, reinforced gypsum composite boards, plasters, machinable materials, joint treatment materials, and acoustical tiles, by adding to the aqueous slurry used to make the gypsum-based product a small amount of a siloxane and a catalyst to enhance the curing of the siloxane. The method comprises mixing a siloxane emulsion with the gauging water used to prepare said gypsum-based article; mixing a dead burned magnesium oxide catalyst with calcined gypsum; mixing the silicone/water mixture with the gypsum/magnesium oxide mixture to